Wild Rice Sulfate Standard Study & Preliminary Analysis

R5 State and Tribal WQS Conference Call
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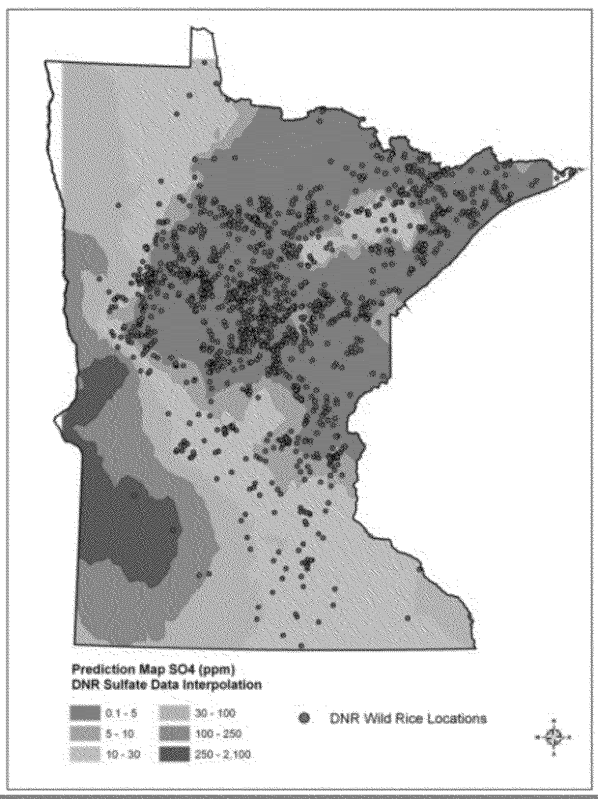
CLEAN WATER LAND & LEGACY AMENDMENT

Wild Rice Sulfate Standard

- Studies found correlation between lower sulfate and wild rice
- Sulfate standard adopted in 1973 to protect wild rice production
  - "10 mg/L, applicable to water used for production of wild rice during periods when the rice may be susceptible to damage by high sulfate levels"

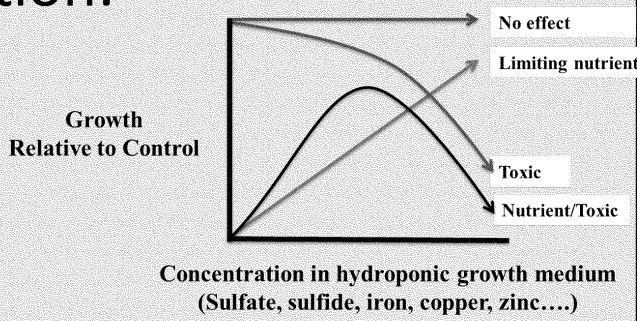


Implementing the Sulfate Standard

- Additional information needed
- Study protocol developed
- 2011 Legislation:
  - $1.5 million for wild rice standards study from the Clean Water, Land and Legacy Amendment
  - Advisory committee to provide input on study protocol, research results and rulemaking
  - MPCA to initiate rulemaking upon completing the study

Wild Rice Standard Study

- Goal: Enhance understanding of the effects of sulfate on wild rice; inform standard evaluation
- Key avenues of investigation:
  - Laboratory experiments
  - Field survey
  - Container experiments
  - Sediment experiments
- Any standard modification will be based on multiple info. sources

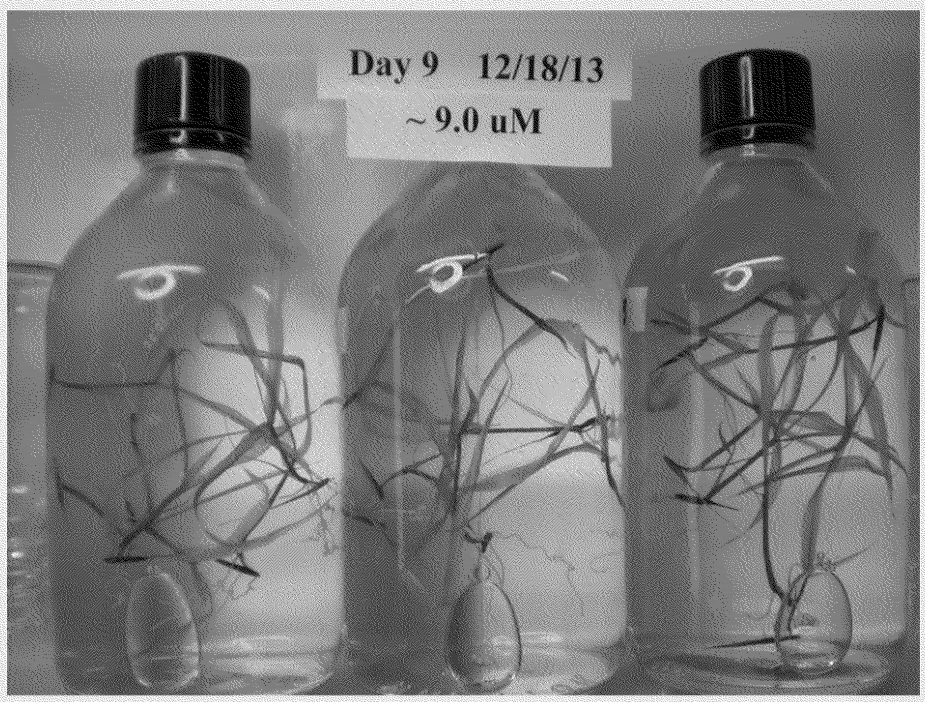


Hydroponic Growth Tests (Dose-Response)

- Germination Test (50 seeds per jar; 3 jars per treatment)
- Juvenile Seedling Test (7 plants per bottle, 3 bottles per treatment)
- Preliminary analysis:
  - Sulfate treatments did not produce statistically-significant impacts in hydroponic tests
  - Sulfide treatments (exposure level #2) did produce a statistically-significant reduction of seedling growth

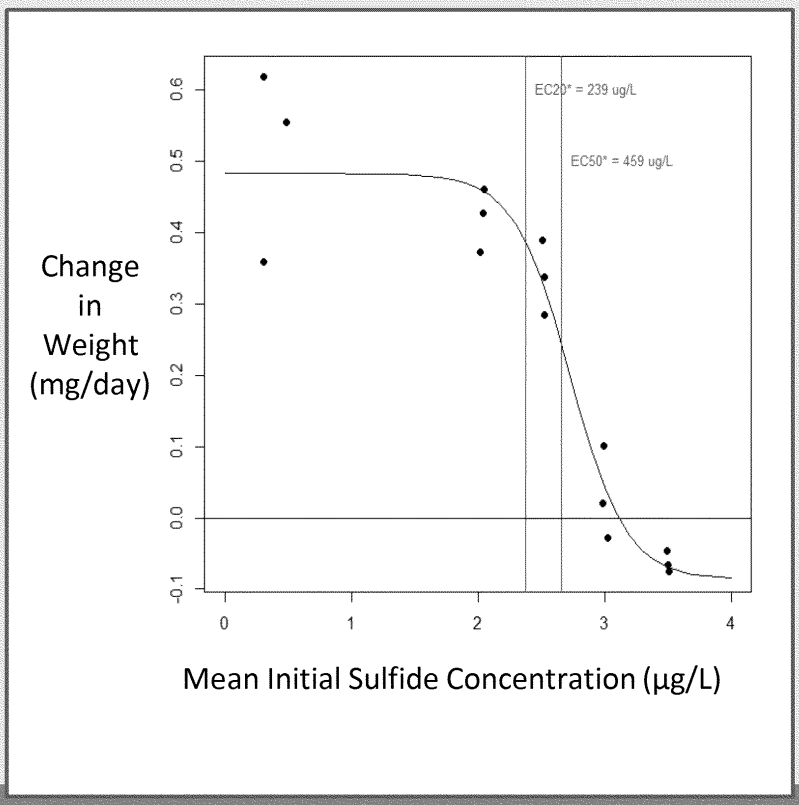
Hydroponic seedling exposures

- Maintaining exposure levels was a challenge, addressed in analysis
- Method exposed whole seedling, which may or may not be an issue

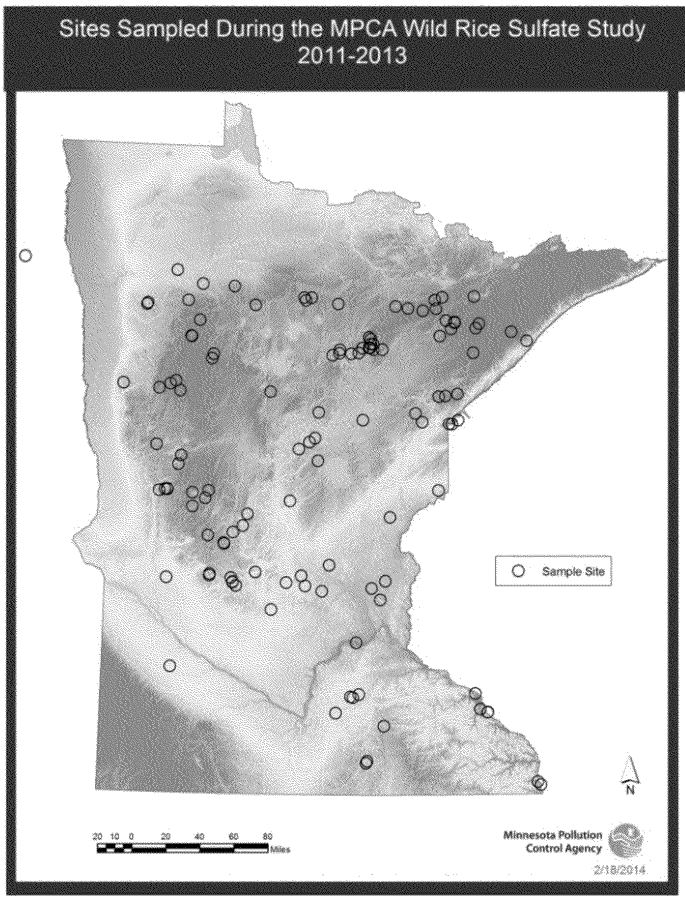


Regression Analysis of Hydroponic Sulfide Seedling Test Results

- Effect concentration estimates can be used to interpret results

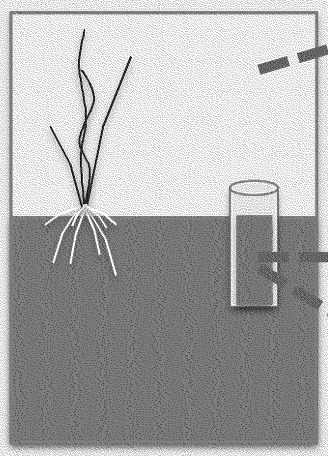


Field Survey



- Can further inform understanding of sulfate-sulfide-wild rice relationship
- Allows examination of other variables
  - Iron, Others?
- Targeted site selection
  - Goal: Characterize potential wild rice habitat across a range of sulfate
  - Comparing to other data

Wild Rice Field Survey



Surface water

Na, K, Mg, Ca, Fe
SO4, Cl
Alkalinity, pH, conductivity, Total P, Total N,
Ammonia, Nitrate + Nitrite, transparency

Bulk Sediment Chemistry

Acid-Volatile Sulfide
Total carbon, phosphorus, nitrogen, sulfur
Phosphorus fractionation
Simultaneously-Extracted Metals:
Fe, Cu, Zn, Co, Ni, Mn, Mo, Se, As, B

Porewater

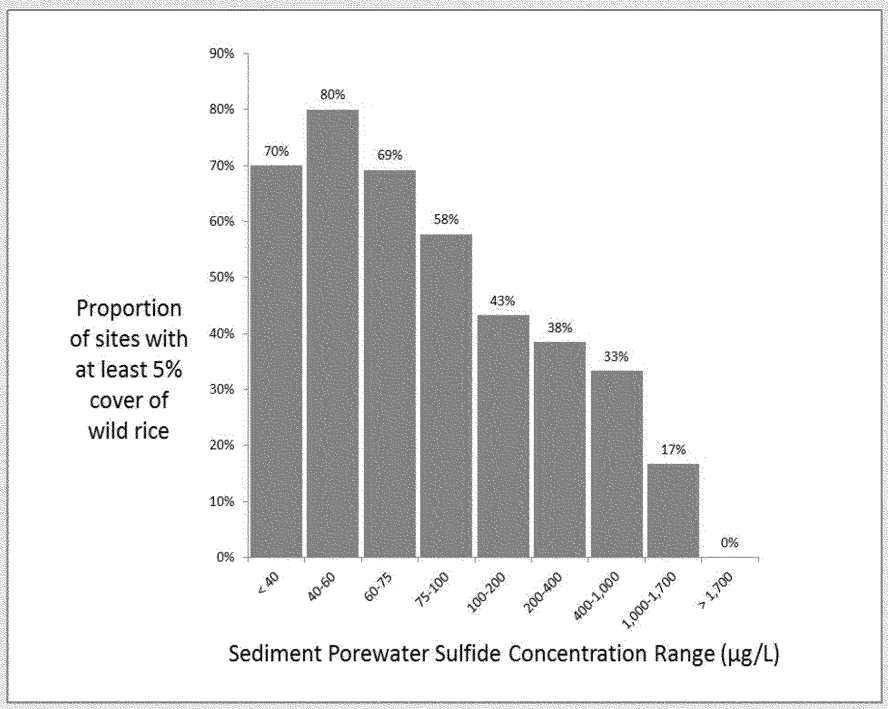
Sulfide
Na, K, Mg, Ca,
SO_4, Cl
Total P, Total N, Silica
Ammonia, Nitrate + Nitrite
DOC (dissolved organic carbon)
Fe, Cu, Zn, Co, Ni, Mn, Mo, Se, As, B

Other Sediment Properties

Water
organic matter
carbonate content
Organic grain size
Wild rice phytolith presence/absence

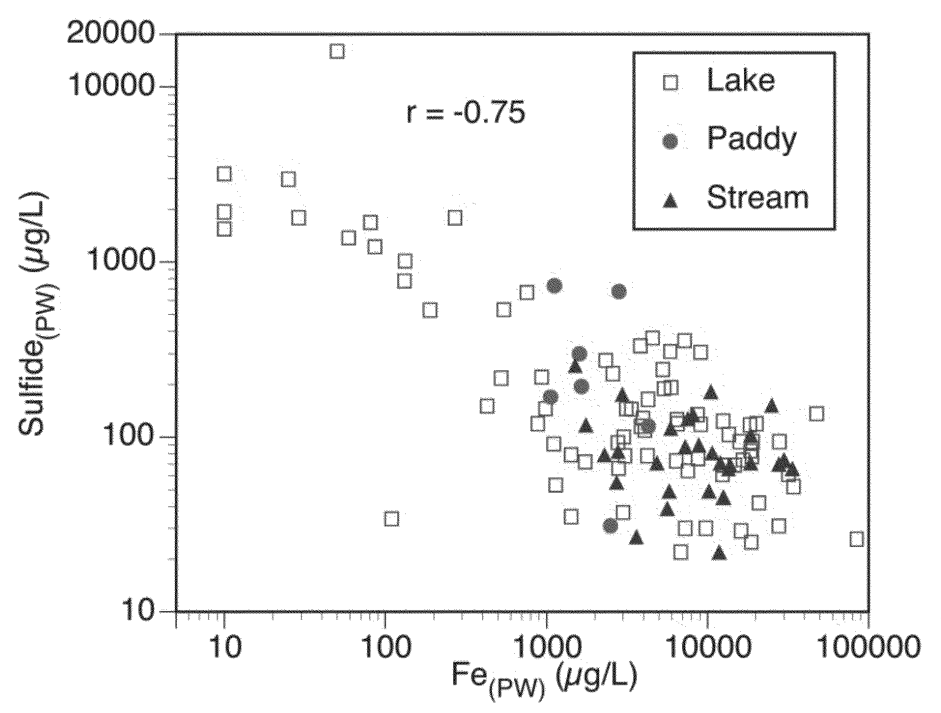
Sediment coring at field site

Proportion of sites with at least 5% cover of wild rice declines with increasing porewater sulfide

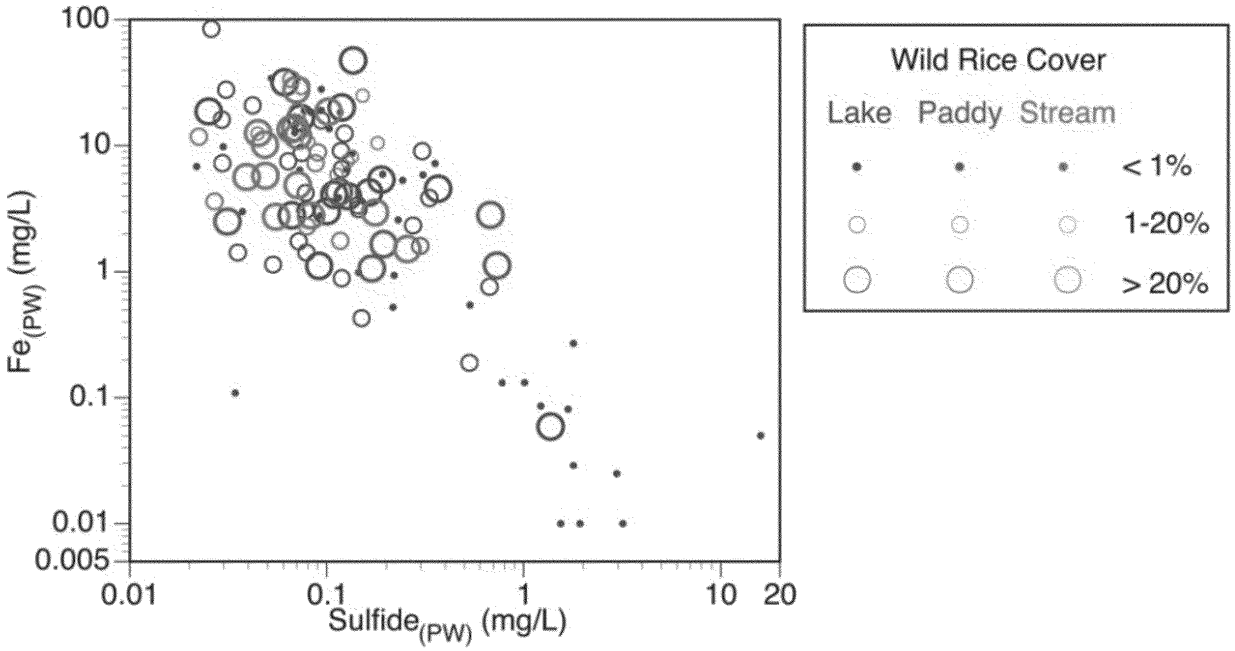


- Field data consistent with observation that wild rice is less successful when porewater sulfide is above 150 to 300 µg/L
- May need to adopt a sediment porewater sulfide standard

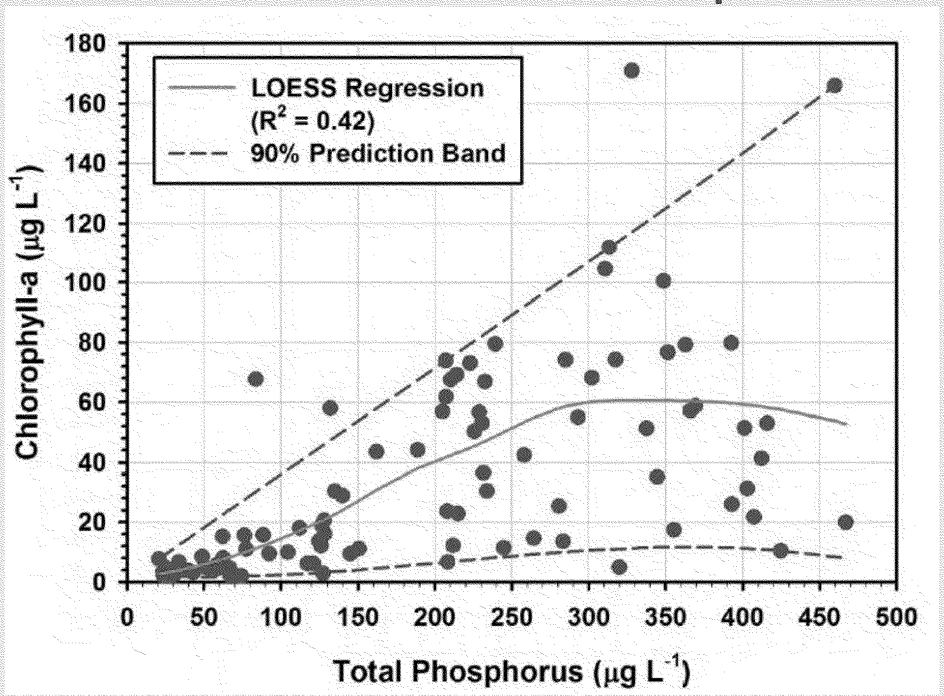
Iron in porewater has a strong role in controlling sulfide in porewater



Wild rice tends to grow where porewater is low in sulfide and high in iron



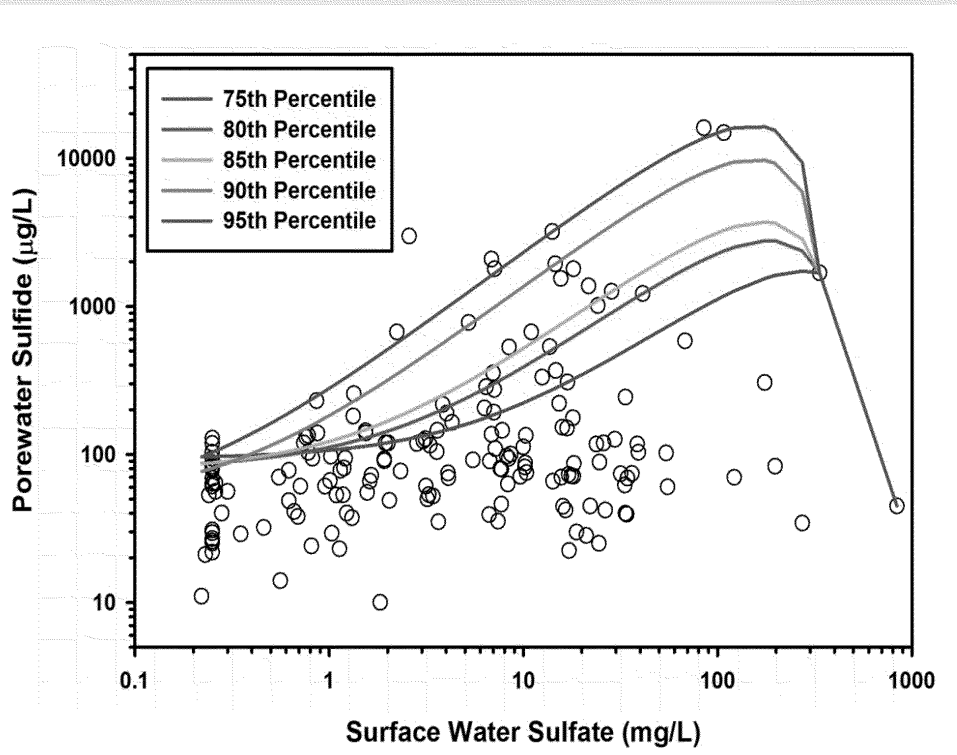
Quantile Regression is an appropriate way to analyze pollutants whose effects have multiple controls



For example:

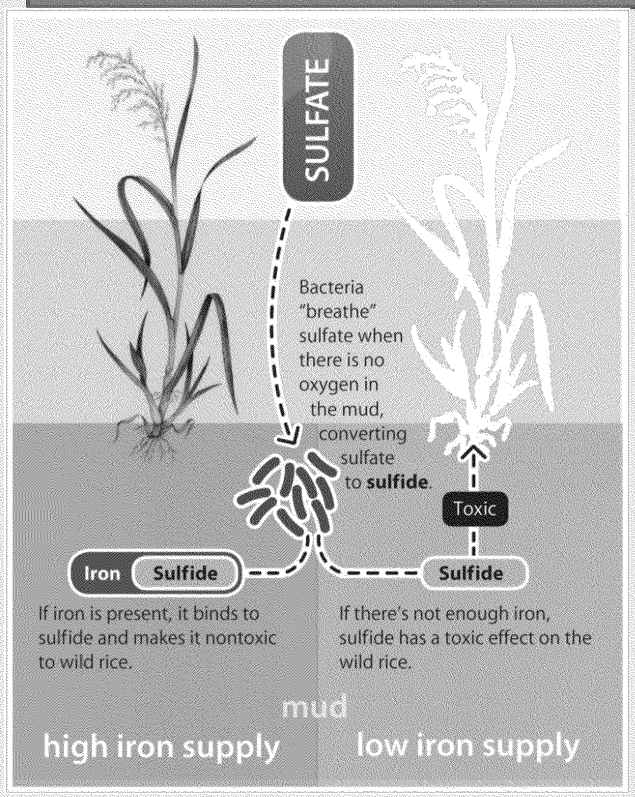
wedge-shaped data between phosphorus and chlorophyll in streams (Fig. 22, Minnesota Nutrient Criteria Development for Rivers).

Quantile regression is a useful way to relate sulfide levels to surface water sulfate



- Analysis continues

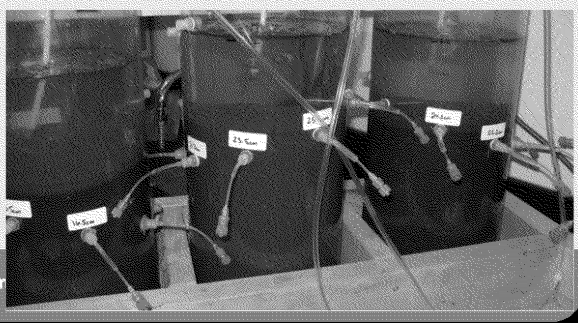
Preliminary Analysis, Summary



- Although sulfate is not directly toxic to wild rice, it can be converted to sulfide, which can be toxic
- Laboratory experiments showed reduced seedling growth when sulfide exceeded 150 to 300 µg/L
  - Field data reinforced this
  - May need a sediment porewater sulfide standard

Preliminary Analysis, Cont.

- Sulfide in the porewater is affected by sulfate in surface water and iron in porewater
- Site-specific standards may be needed
- Continue to examine if characteristics of water body type affect sulfide concentrations
- Further explore “period of susceptibility” of wild rice to sulfate



Next Steps

- Feedback from Advisory Committee
- Meetings with interested parties
- Continue data analysis è scientific review doc.
- Expert scientific review – summer 2014
- If MPCA recommends change to standard:
  - Develop Technical Support Document
  - Initiate formal rulemaking
  - Informal and formal comment opportunities
- Also exploring implementation & policy questions

More about Scientific Peer Review

- Contracted with independent company -- ERG

Activity	**Date/Timeframe** **DRAFT**
MPCA continues to refine the analysis, considering feedback received	April – May 2014
MPCA review document and technical charge sent to peer reviewers and Advisory Committee	Early June 2014
Advisory Committee members submit feedback on review document; ERG sends this feedback to peer reviewers for their consideration	Late June/Early July 2014
Peer review meeting held	Early August 2014
Final meeting summary from ERG	Early September 2014

Thank You!

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